

ZHARKOV, V.P.; CHAYKUSKY, M.F.

Designing slide-wire pickups for measurements of large linear
displacements. Avtom. kont. i izm. tekhn. no. 1:112-116 '57.
(Electric measurements) (MIRA 11:6)

CHAYEVSKIY, M. I.

24-9-19/33

AUTHOR: Chayevskiy, M. I. (L'vov).

TITLE: On the brittle fracture of low carbon steel caused by the effect of hydrogen. (O khrupkom razrushenii malouglerodistoy stali v rezul'tate deystviya vodoroda).

PERIODICAL: Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk, 1957, No.9, pp. 121-122 (USSR)

ABSTRACT: For elucidating the influence of electric corrosion protection on the mechanical properties of steels located inside acidic media, the author carried out rupture tests of specimens during electroplating and electropolishing. The tests were carried out in a specially designed set-up, a drawing of which is shown in Fig.1, p.121. The carried out tests indicate that atomic hydrogen penetrates particularly intensively into the metal along the lines of plastic sliding throughout the entire volume of the metal. This elucidates the fact that brittle fracture of the specimens occurred at an angle of about 45° and that in the fracture zone the metal is very considerably loosened, as shown in Figs.2 and 4 for three specimens. To verify the assumption that the brittle fracture results from hydrogen penetration, separate experiments were made

Card 1/2 with specimens fitted with satchets filled with manganese

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On the brittle fracture of low carbon steel caused by the effect of hydrogen.

peroxide and potassium bichromate; the fracture of specimens thus protected during electroplating does not differ from the fracture of specimens in air. The obtained experimental results indicate that cathodic protection, which can give almost complete protection from corrosion, cannot be recommended for protecting loaded components located inside acidic media since this will result in the steel absorbing hydrogen and becoming brittle.

There are 4 figures and 7 references, all of which are Slavic.

SUBMITTED: March 14, 1957.

AVAILABLE: Library of Congress.

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AUTHORS: Podstrigach, Ya. S., Chayevskiy, M. I. SOV/20-121-2-20/53

TITLE: The Influence of Internal Friction on the Fatigue Failure of Cyclically Deformable Parts (Vliyaniye vnutrennego treniya na ustalostnoye razrusheniye tsiklicheski deformiruyemykh detaley)

PERIODICAL: Doklady Akademii nauk SSSR, 1958, Vol. 121, Nr 2, pp. 268 - 270 (USSR)

ABSTRACT: When investigating the fatigue strength of steel samples it became evident that in a torsion with alternating sign and large amplitudes the breaking of machine part begins with the development of a high number of longitudinal surface cracks which finally unite to transverse cracks (see Fig 1). When heating the samples intensively the breaking occurs in consequence of the temperature stresses. The authors investigated cylindrical samples under the influence of torsion and temperature increase. The formula for the relation between the occurring stresses τ and the angle of shear γ is

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$\tau = G\gamma + \frac{\phi}{2\pi} G\gamma_0 \sqrt{1 - (\gamma/\gamma_0)^2}$, where G denotes the shear modulus, ϕ the coefficient of energy distribution and γ_0 the amplitude value of γ . Investigations on the temperature distribution gave the result that modifications of the medium surrounding the machine part or of the temperature of this medium cannot save the production part from temperature stresses. The fatigue strength of cylindrical samples depends among other things on its diameter; in investigations on torsion e.g. it was ascertained that the increase of the diameter from 10 to 200 mm caused a decrease of fatigue strength down to 40 - 50%. There are 3 figures and 10 references, 9 of which are Soviet.

ASSOCIATION: Institut mashinovedeniya i avtomatiki Akademii nauk SSSR
(Institute of **Mechanical Engineering** and Automation, AS USSR)

PRESENTED: January 10, 1958, by P.A. Rebinder, Member, Academy of Sciences,
Card 2/3 USSR

The Influence of Internal Friction on the Fatigue
Failure of Cyclically Deformable Parts

SOV/20-121-2-20/53

SUBMITTED: January 8, 1958

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CHAYEVSKYY, m. I.

PHASE I BOOK EXPLOITATION

80V/4383

Akademiya nauk URSR. Instytut mashynoznavstva ta avtomatyky

Temperaturni napruzhennya v tonkostinnykh konstruktsiyakh (Thermal Stresses in Thin-Walled Structures) Kyiv, 1959. 173 p. Errata slip inserted. 1,000 copies printed.

Resp. Ed.: M. Ya. Leonov, Doctor of Physics and Mathematics, Professor;
Ed. of Publishing House: N. M. Labinova; Tech. Ed.: T. Ya. Mazuryk.

PURPOSE: This collection of articles is intended for technical personnel in the machine industry.

COVERAGE: These articles deal mainly with analyses of temperature fields and thermal stresses in shells and plates. Experimental methods of investigation of the state of stress in machine parts under nonuniformly distributed temperatures are described. No personalities are mentioned. References accompany each article.

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Thermal Stresses in Thin-Walled Structures

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Yarema, S. Ya. Thermal Stresses in Circular Cylindrical and Spherical Shells

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The author presents a solution of the problem of determining the state of stress and strains in circular cylindrical and spherical shells under arbitrary nonuniformly distributed temperatures by means of the general theory of shells. He also recommends design methods and discusses boundary conditions.

Yarema, S. Ya. Temperature Field and Thermal Stresses in Boiler Barrels During Starting and Stopping

100

The author presents results of calculations of thermal stresses in boiler barrels during starting and stopping. The shape of the temperature field of the barrel is determined on the basis of analysis and generalization of results of experimental measurements. All-directional temperature nonuniformities are also taken into consideration. In this case the barrel is treated as a thin shell. The selection of allowable temperature

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differences in the barrel based on stress analysis is also discussed.

Podstrigach, Ya. S. Temperature Field in Walls of Constant Thickness Under an Asymptotic Thermal Regime

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The author presents a method for determining the temperature field under an asymptotic thermal regime for the case when the boundary temperature values can be presented as polynomials with time. He also gives examples of the temperature distribution across the thickness of plane, cylindrical, and spherical walls.

Podstrigach, Ya. S., and G.V. Plyatsko. State of Stress in a Strip Under Uniform Heating of One of Its Edges

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The author presents a solution for the problem of the thermoelasticity of an unrestrained long strip with a width considerably exceeding its thickness. The temperature field and the state of stress in the strip are determined for conditions of an asymptotic thermal regime. He also discusses

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the state of stress in a strip caused by local heating of one of the edges.

Flyatsko, G.V. On the Thermal Stresses in a Hollow Cylinder During Heating

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The author determines the temperature field corresponding to an asymptotic thermal regime in an infinite hollow cylinder when the temperature of the inner wall depends on the polar angle and increases proportionally with time, and the external surface is cooled with a constant-temperature coolant. From the temperature field obtained the thermal stresses are determined.

Chayevskiy, M.I. Electronic Instrument for Simultaneous Recording of Stresses and Temperatures in Machine Parts

146

The author describes the construction and operating principle of an electronic instrument for simultaneous recording of stresses and temperatures. The nature of changes in stresses as related to changes in temperature is also discussed.

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X Chayevs'ky, M.I. Experimental Investigation of Stresses in
Machine Parts at Elevated Temperatures

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The author describes some methods involving the use of
wire-type strain gages for measuring thermal stresses.
These methods are compared with those more commonly used.

Kornilov, G.I. Investigation of Heating and Heat Exchange
in Worm Gearing

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The author discusses the process of heat generation in the
contact zone of worm gearing and heat exchange in the housing
of a self-lubricating worm-gear speed reducer. Data are given
on temperatures of external and internal housing surfaces in the
contact zone. Recommendations are made for increasing operating
efficiency at elevated temperatures by using high-viscosity
lubricants.

AVAILABLE: Library of Congress (TA492.C9A6)

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VK/pw/mas
10-24-60

SOV/179-59-1-13/36

AUTHORS: Podstrigach, Ya. S. and Chayevskiy, M. I. (Lvov)

TITLE: Temperature Stresses Caused by Internal Dissipation of Energy and Their Influence on the Fatigue Strength of Components (O temperaturnykh napryazheniyakh, obuslovlennykh vnutrennim rasseivaniyem energii, i ikh vliyaniy na ustalostnuyu prochnost' detaley)

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Mekhanika i mashinostroyeniye, 1959, Nr 1, pp 97-102 (USSR)

ABSTRACT: In fatigue testing of components, it is sometimes found that failure occurs at an unusually low stress, and that the failing load may depend on the size of the specimen. In the present paper, the effect of internal friction on the fatigue strength is investigated. Internal friction in a specimen undergoing test leads to the evolution of heat which in turn leads to the development of thermal stresses. Equations are obtained for thermal stresses in a twisted and a bent specimen. It is found that the radial and axial stresses in torsion

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Temperature Stresses Caused by Internal Dissipation of Energy and
Their Influence on the Fatigue Strength of Components

depend on the size of the specimen and this provides a
possible explanation for the observed effect of specimen size
on fatigue strength. There are 5 figures and 13 references,
10 of which are Soviet, 2 English and 1 German.

SUBMITTED: February 7, 1958.

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32621

S/137/61/000/011/083/123
A060/A101

188200 1413

AUTHOR: Chayevskiy, M. I.

TITLE: Some preliminary data on the influence of melts of low-melting metals upon the fatigue strength of carbon steels

PERIODICAL: Referativnyy zhurnal. Metallurgiya, no. 11, 1961, 51, abstract 11Zh306 ("Byul. In-t metallokeram. i spets. splavov AN USSR", 1959, no. 4, 86 - 95)

TEXT: The author investigates the influence of the Sn melt and stress concentrator upon the fatigue strength at high temperatures (300 - 500°C) of steel 35 and 45 in the annealed state (1,000°C soaking for 1 hr). The tests were carried out upon a special machine with a circular bending by a centrifugal force upon a permanently fastened cantilever specimen. The force acting upon the specimen was determined by means of an elongation dynamometer and wire sensors. It was established experimentally that the value of σ_w in the case of the action of a Sn melt and stress concentrator (circular recess) is greater by approximately 50% than in the case of testing in air. This is explained by the increase in the plasticity of the metal, and consequently a reduction in the stress concentration on account

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A060/A101

Some preliminary data on the...

of the surface of recess being wetted by the Sn. The endurance of unpre-tinned specimens tested in molten Sn at low stresses is lower than the endurance of pre-tinned specimens, and is higher at high stresses. The results of the experiments indicate that the action of molten Sn upon the fatigue strength of steel is not as adverse as could have been expected on the basis of the experience of other investigators. However, additional studies are required for recommending carbon steels for operation under conditions of being acted upon by molten metals. There are 35 references. X

S. Gurevich

[Abstracter's note: Complete translation]

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AUTHOR: Chayevskiy, M.I.

SOV/126-8-5-25/29

TITLE: Effect of the Test Temperature on the Fatigue Strength²
of Carbon Steel Specimens having Stress Concentrators
which are Under the Influence of the Pb-Sn Eutectic Melt³

PERIODICAL: Fizika metallov i metallovedeniye, Vol 8, 1959, Nr 5,
pp 789-791 (USSR)

ABSTRACT: The effects of molten metals on steel, as a result of which a change of its mechanical properties is observed, can be of several inter-related types: (1) adsorption action; (2) solution of the basic part of the alloy, or of the component parts holding the crystals together; (3) chemical reaction with the steel of either the liquid metal or inclusions contained in it (various types of oxides). Apart from the above, diffusion processes take place. As shown by experiments (Fig 1) one or the other type of reaction can predominate, depending on the temperature at which testing is carried out. Fig 1 shows the influence of temperature on the fatigue strength of specimens with stress concentrators, made from the carbon steel 35 and tested in the molten Pb-Sn eutectic. Fig 2 shows the nature of the change in

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Effect of the Test Temperature on the Fatigue Strength of Carbon Steel Specimens having Stress Concentrators which are Under the Influence of the Pb-Sn Eutectic Melt

mechanical properties of the metal in tension under the action of a surface-active substance: (1) testing in air, (2) testing in a surface-active medium. Figs 3 and 4 show fatigue strength curves for specimens with stress concentrators, made from steel 35 ($H_{R_B} = 80 \pm 1$).

In Fig 3; curve 1 - testing of specimens which were earlier coated with a layer of Pb-Sn eutectic in a melt of Pb-Sn eutectic at 400 °C ($n = 50$ cycles per second); curve 2 - testing of specimens in a Pb-Sn eutectic melt at 400 °C; curve 3 - testing of specimens in air at 400 °C; and curve 4 - testing of specimens in air at 20 °C. In Fig 4; curve 1 - testing of specimens preliminarily coated by a Pb-Sn eutectic layer in a Pb-Sn eutectic melt at 500 °C; curve 2 - testing of specimens in air at 500 °C; and curve 3 - testing of specimens in air at 20 °C. In order to be able to draw a conclusion about the possibility of applying cyclically deformed steel together with metallic melts for structural purposes, the rate at which the restricted

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endurance limit drops with increase in testing time due to solution of the steel, must be determined.

There are 4 figures and 8 references, of which 7 are Soviet and 1 is English.

ASSOCIATION: Institut mashinovedeniya i avtomatiki AN SSSR
(Institute of Machine Construction and Automation,
Card 3/3 Academy of Sciences USSR) ✓

SUBMITTED: November 1, 1958

18(3)

AUTHOR:

Chayevskiy, M. I.

SOV/20-124-5-24/62

TITLE:

The Influence of a Melt of Tin on the Fatigue Strength of the Samples of a Steel With Concentrators of Stress (Vliyaniye rasplava olova na ustalostnuyu prochnost' obraztsov stali s kontsentratorami napryazheniya).

PERIODICAL:

Doklady Akademii nauk SSSR, 1959, Vol 124, Nr 5, pp 1049-1051 (USSR)

ABSTRACT

The steel samples mentioned in the title are of carbonaceous steel. Tests were carried out by means of a machine specially constructed for this purpose. The working principle of this machine is based essentially on the circular bending of an immobile fixed bracket-like sample by centrifugal force. According to the results of these tests, the fatigue strength limit of the steel samples investigated (with stress concentrators) increases under the influence of the tin melt at $t = 300$ by about 50 % as against the fatigue strength limit at about the same temperature in the air. At the first glance, this result does not seem to agree with existing conceptions, according to which the strength of the steel samples decreases as a result of the reduction of surface energy due to adsorp-

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The Influence of a Melt of Tin on the Fatigue Strength SOV/20-124-5-24/62
of the Samples of a Steel With Concentrators of Stress

tion. However, a more accurate analysis shows that there is no contradiction whatever. Under the action of surface-active substances the plasticity of metal may increase if the level of normal stresses does not exceed a certain amount. The tin melt wettens the surface of the recess of the concentrator and thus increases the plasticity of the metal. In this way the effect of stress concentration is reduced and the fatigue strength is increased. Together with the increase of fatigue strength, also the concentrator may possibly "heal" by the increase of plasticity under the influence of the tin melt. The author thanks Professor P. A. Rebinder, Professor V. I. Likhtman, and Professor G. V. Karpenko for raising the problem and for some important advice. There are 2 figures and 13 references, 11 of which are Soviet.

ASSOCIATION: Institut mashinovedeniya i avtomatiki Akademii nauk USSR
(Institute for Machine Construction and Automation of the Academy of Sciences, UkrSSR)

PRESENTED: October 16, 1958, by P. A. Rebinder, Academician

SUBMITTED: August 21, 1958
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SOV/20-125-2-21/64

18(3), 18(7)
AUTHOR:

Chayevskiy, M.I.

TITLE:

On the Mechanism of the Increase of the Fatigue Strength of Elasto-plastic Materials Which, in Cyclic Deformation, Are Liable to Harden, Under the Influence of Strong Surface-active Substances (O mekhanizme povysheniya ustalostnoy prochnosti uprugoplasticheskikh materialov, sklonnykh pri tsiklicheskom deformirovani k uprochneniyu, pod vozdeystviyem sil'nykh poverkhnostno-aktivnykh ~~veshchestv~~)

PERIODICAL:

Doklady Akademii nauk SSSR, 1959, Vol 125, Nr 2, pp 319 - 322 (USSR)

ABSTRACT:

In two earlier papers (Refs 1,2) the author showed that by the action of a tin melt brought to bear on cyclically deformable steel samples fatigue strength may be increased. The author discusses an explanation of this phenomenon on the basis of the papers by P.A. Rebinder et al. (Refs 3,4), which show that the yield point of metals is decreased under the influence of surface-active substances, and that the deformability of metals is increased. Some results obtained by these experiments are discussed in the present paper. Also the influence exerted by a eutectic Pb-Sn-alloy upon steel increases the latter's fatigue strength. The author investigates a detailed mechanism for the action of

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On the Mechanism of the Increase of the Fatigue Strength of Elasto-plastic Materials Which, in Cyclic Deformation, Are Liable to Harden, Under the Influence of Strong Surface-active Substances

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surface-active substances on the fatigue strength of elasto-plastic materials which are liable to harden in the case of cyclic deformation. Such a sample is now to be investigated with respect to fatigue strength in the case of bending. The ranges of plastic deformation at the points of stress peaks are assumed to be small and not to exercise any influence on the deformation of the sample as a whole. In the ideal case the cyclically deformed plastic zone must be elastic. In reality, hardening occurs up to a certain limit, beginning with work for the plastic deformation must then be performed. In the case of surface-active media acting upon the cyclically deformable plastic zone of the surface layers of a metal three different cases may occur: a) action by relatively weak surface-active substances (e.g. various fats); b) action of strong surface-active substances (e.g. by the alloys of easily meltable metals); c) the action of surface-active substances begins after a certain interval of time after cyclic deformation has set in. In case a) the elasticity modulus of the plastic zone of the surface layers changes practically only little. In case b) (especially in the case of metal alloys) the character of

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On the Mechanism of the Increase of the Fatigue Strength of Elasto-plastic Materials Which, in Cyclic Deformation, Are Liable to Harden, Under the Influence of Strong-Surface-active Substances

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hardening changes somewhat. Under the action of strong surface-active substances not only the yield point value is considerably reduced, but also the elasticity modulus of the plastic zone of the surface layers of the metal. Adsorption of the surface active substance and wetting of the surface of the plastic zone of the surface layers of the metal cannot occur simultaneously (case c).

ASSOCIATION:

There are 2 figures and 10 references, 9 of which are Soviet. Institut mashinovedeniya i avtomatiki Akademii nauk USSR (Institute of Machine Science and Automation of the Academy of Sciences, UkrSSR)

PRESENTED:

October 16, 1958, by P.A. Rebinder, Academician

SUBMITTED:

September 7, 1958

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CHAYEVSKIY, M.I.

Experimental determination of thermal stresses with wire resistance
gauges. Izv.tekh. no.2:14-16 F '60. (MIRA 13:6)
(Thermal stresses--Measurement)

S/126/60/010/004/016/023
E193/E483

AUTHOR: Chayevskiy, M.I.

TITLE: Application of Molten Tin and Tin-Lead Eutectic as Means of Increasing the Strength of Machine Parts Subjected to Cyclic Deformation

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol 10, No.4, pp.604-608

TEXT: It has been established earlier by the present author that the fatigue strength of notched steel, coated with molten tin or tin-lead eutectic, was considerably higher than that of uncoated specimens. This effect has been attributed to the increase in plasticity of steel at the root of the notch in the presence of a layer of molten alloy and to the resultant decrease in the stress concentration in this region. The object of the investigation, described in the present paper, was to check the validity of this hypothesis and to find out whether other alloys would have a similar effect. To this end, fatigue tests have been carried out under various conditions on notched specimens of steel 50 and 1X18N9T (Khl8 N9T), coated with Pb-Sn and Pb-Bi eutectics. Contrary to the expectations, the test pieces coated with molten Pb-Bi eutectic

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Increasing the Strength of Machine Parts Subjected to Cyclic
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displayed fatigue strength considerably lower than either uncoated specimens, or those coated with the Pb-Sn alloy. This seemed to indicate that the beneficial effect of Sn or Pb-Sn alloy is associated not only with the effect of the molten coating on the plasticity of steel in the highly stressed region but also with those diffusion and chemical processes that take place between molten tin and stressed (deformed) steel. This view was confirmed by the results of experiments carried out at 400°C on specimens (a) immersed in a bath of molten Pb-Sn eutectic and (b) tinned with this alloy and then tested in air. Although in the latter case the Pb-Sn coating became gradually oxidized, so that it could no longer increase the plasticity of steel at the root of the notch, the increase in the fatigue strength was the same as in the former case. It might be inferred therefrom that the increase in strength of coated specimens is due exclusively to the physico-chemical processes accompanying tinning of steel. This, however, is not true since the fatigue strength of tinned specimens, tested at room

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temperature, was 30 to 35% lower than that of uncoated material tested under the same conditions. Based on both experimental results and theoretical considerations, the following explanation of the observed facts is suggested by the present author: the action of the layer of the molten metal (or alloy) is of particular importance in the initial stage of the cyclic deformation, when it increases the plasticity of steel at the root of the notch by relieving the localized, normal, internal stresses set up at the head of the array of dislocations in the metal surface layer which, under normal conditions, can form an obstacle for the moving dislocations. However, the increased plasticity of the critical region will not automatically lead to an increase in the fatigue strength unless the molten alloy is prevented from penetration in the interior of the stressed material along the structural defects (cracks) formed in the course of deformation. When an Sn or Pb-Sn coating is applied an intermetallic compound, FeSn_2 , is formed at the molten layer-steel interface. Since the lattice parameters

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of this phase are larger than those of Fe, compressive stresses are set in the surface layer of steel, whereby further penetration of the molten metal into the interior of the deformed specimen is prevented, or considerably slowed down. Neither Pb nor Bi react with iron and it is for this reason that a Pb-Bi coating not only fails to increase the fatigue strength of notched steel specimens but, on the contrary, accelerates the process of fracture. There are 4 figures and 9 references: 7 Soviet and 2 English. ✓

ASSOCIATION: Institut mashinovedeniya i avtomatiki AN USSR
(Institute of Automation and Mechanical Engineering
AS UkrSSR)

SUBMITTED: April 25, 1960

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CHAYEVSKIY, M.I.

Role of physicochemical processes in the surface layers of steel during cyclic deformation in low-melting liquid metals. Dokl. AN SSSR 134 no.6:1399-1402 O '60. (MIRA 13:10)

1. Institut mashinovedeniya i avtomatiki Akademii nauk USSR. Predstavleno akademikom P.A.Rebinderom.
(Steel--Testing)

KARPENKO, G.V., otv. red.; LEONOV, M.Ya., doktor fiz.-mat. nauk, zam. otv. red.; KRIPYAKEVICH, R.I., kand. tekhn. nauk, red.; MAKSIMOVICH, G.G., kand. tekhn. nauk, red.; PANASYUK, V.V., kand. fiz.-mat. nauk, red.; PODSTRIGACH, Ya.S., kand. fiz.-mat. nauk, red.; STEPURENKO, V.T., kand. tekhn. nauk, red.; TYNNYY, A.A., kand. tekhn. nauk, red.; CHAYEVSKIY, M.I., kand. tekhn. nauk, red.; YAREMA, S.Ya., kand. tekhn. nauk, red.; REMENNIK, T.K., red. izd-va; LISOVETS, A.M., tekhn. red.

[Machines and devices for testing metals] Mashiny i pribory dlia ispytanii metallov. Kiev, Izd-vo Akad.nauk USSR, 1961. 132 p. (MIRA 15:2)

1. Akademiya nauk URSR, Kiev. Instytut mashinovedstva i avtomatyky. 2. Chlen-korrespondent Akad. nauk USSR (for Karpenko).
(Testing machines)

S/735/61/000/000/002/014

AUTHORS: Chayevskiy, M.I., Tynnyy, A.N.

TITLE: A machine for cyclic torsional testing with simultaneous or separate application of a constant torque and a constant tension force.

SOURCE: Akademiya nauk Ukrainskoy SSR. Institut mashinovedeniya i avtomatiki. Mashiny i pribory dlya ispytaniy metallov. Kiyev, 1961, 11-18.

TEXT: A testing machine constructed by the authors and its electric control circuitry are described. Some test data are adduced. The specific problem examined is that of the interrelation of normal stresses in the theory of fatigue failure. The point of departure of the current work is the study of the effect of the stress range on the fatigue strength of metals by I.O.Smith (Univ. of Ill. Bull., v. 39, no. 26, Engrg. Exp. Sta. Bull., ser. no. 334, 17 Feb. 1942), who concluded that the tensile-compressive fatigue strength of brittle metals depends strongly, and the strength of plastic metals depends to a smaller degree, on the value of the mean stress, and that in cyclic torsional tests in the presence of a constant tangential stress the fatigue strength of brittle metals was severely affected by the magnitude of the mean tangential stress, whereas plastic metals remain almost unaffected. There remained to be ascertained the effect of a tensile stress on the cyclic-torsion fatigue strength, particularly to verify the statements of other authors (Stulen, F., et al.,

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A machine for cyclic torsional testing ...

A failure criterion for multiaxial fatigue stresses, Am. Soc. f. Test Mat's, Proc., v. 54, 1954; Ponomarev, S. D., et al., Osnovy sovremennykh metodov rascheta na prochnost' v mashinostroyenii. Moscow. Mashgiz, 1952) and to investigate further the effect of residual stresses on fatigue strength. The machine designed therefor includes exposure to various surface-active and corrosive liquid media at normal and elevated temperatures. An electrically shaft-driven 20-50-cps oscillator of given moment of inertia and spring-controlled stiffness transmits a specified angular range and strain-gage-measured torque into a clamp holding one end of the specimen. The other end of the specimen is held by a shaft coaxial with the oscillator; said shaft is subjected to a tensile force via a weight-loaded hinged lever and to a practically constant torque via a weight-loaded thread wound around a large and heavy seismic-mass disk with a proper cycle of 1 sec^{-1} , thereby eliminating any effect of specimen creep at high temperatures and intense loads. Details of the compensation-type electronic regulator are explained in the author's paper "Machine for fatigue testing with a hermetic chamber," in the same compendium as the present paper, pp. 54-61 (abstract S/735/61/000/000/007/014). The automatic cut-off device actuated upon failure of the specimen is described. The electric motor and heater are fed by an autotransformer. The temperature control is effected by an ЭПБ-01 (EPV-01) electronic potentiometer. There are 4 figures and 6 references (4 Russian-language Soviet and 2 English-language U.S. as cited in the abstract).

ASSOCIATION: None given.

S/735/61/000/000/003/014

AUTHORS: Chayevskiy, M. I., Popovich, V. V., Karpenko, G. V.

TITLE: A machine for the investigation of elastic-plastic torsional deformations.

SOURCE: Akademiya nauk Ukrainesoy SSR. Institut mashinovedeniya i avtomatiki. Mashiny i pribory dlya ispytaniy metallov. Kiyev, 1961, 19-25.

TEXT: The design of a machine for torsional testing of steel specimens at high temperatures (T), in contact with various fluid media, and with large cyclic deformations, is described. Test data for normalized steel "50" at room temperature are adduced. The machine was developed to provide an experimental means for a determination of whether or not to include cyclically alternating torsional-stress conditions implying elastic-plastic deformation as reasonable design conditions for certain power-plant elements, such as tubes and boilers, which may undergo a relatively small number of such cycles in their operational life span. The vertically oriented specimen is clamped rigidly at its lower end. The upper, rotatable, strain-gage-dynamometer clamp is twisted by a 0.6-kw, 1410 rpm, reversible electric motor via a two-stage $1:30 \times 1:64 = 1:1920$ worm-gear train (angular rate - 4.6 rad/min). The angular travel of the clamp is measured by a rheochord. The motor-reversal switch is actuated by travel-limiting stops for fixed-deformation tests and

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A machine for the investigation of elastic-plastic... S/735/61/000/000/003/014

by strain-gage signals for fixed-torque tests (the strain gages are water-cooled to avoid temperature effects). The signals issuing from the rheochord and the strain gages are recorded by a coordinate recorder for the purpose of tracing the hysteresis loop (cf. Chayevskiy, M.I., in Zbornik "Temperaturni napruzhyennya v tonkostinnykh konstruktsiyakh - T stresses in thin-walled structures." Vyd-vo AN URSR, 1959). During fixed-torque tests the signals issuing from the strain gages are fed into a bridge circuit, the unbalance of which energizes a reversible ПД-9 (RD-9) motor which drives both a balancing rheostat and a switch-actuating cam; vernier adjustments are available for enhanced precision, with reference to the extreme points of the recorded graph. A multisection resistance heater with 3-mm-dia NiCr wire coils maintains a T to within $\pm 1^{\circ}\text{C}$ along the specimen with the aid of an ЭПВ-01 (EPV-01) potentiometer. A metal container embracing the specimen is used for tests in a fluid medium. A sample recording of a room-temperature test in air of a normalized steel-50 specimen shows that the first complete cycle results in a toughening of the metal and that subsequent cycles are practically stable, but are affected by some stress asymmetry. A summary graph for the same test shows the number of cycles to failure as a function of (1) the angle-of-twist amplitude and (2) the maximal tangential stresses, also (3) the plastic-deformation work A (kg/cm) as a function of the maximum tangential stress τ (g/cm²). The latter curve is well approximated by $A = (1/3) \cdot 10^{-6} \tau^6$. There are 3 figures and 1 Ukrainian-language ASSOCIATION: None given. || Soviet reference.

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AUTHOR: Chayevskiy, M.I.

TITLE: A machine for oscillatory torsion-bending fatigue testing.

SOURCE: Akademiya nauk Ukrainskoy SSR. Institut mashinovedeniya i avtomatiki. Mashiny i pribory dlya ispytaniy metallov. Kiyev, 1961, 35-40.

TEXT: Description of a testing machine in which the torsion-bending oscillations are produced by a non-coaxial vibrator. The magnitude of the bending oscillations is regulated by the centrifugal force and the rigidity of a support mandrel. High-temperature tests and tests within various fluid media are feasible. The specimen has a useful portion 16 mm in dia and 60 mm long. It is rigidly clamped at its lower end. The upper end of the specimen is clamped in a dynamometer shoes which is center-supported by a coaxial mandrel of suitably selected rigidity and length, rigidly clamped at its upper end. The upper specimen clamp is also fastened to a radial crank, at the end of which an unbalanced disk, driven by an electric motor, produces vibrations of specified intensity and amplitude. A rigid (and short) support mandrel will inhibit the flexural oscillations of the specimen without interfering with the torsional oscillations; a less rigid (and longer) support mandrel will expose the specimen to both the flexural and the torsional oscillations.

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↑ machine for oscillatory torsion-bending fatigue testing. S/735/61/000/000/004/014

Surface wire strain gages attached to the dynamometer shoe and the support mandrel afford close control of the magnitude and the constancy of the torque and the bending moments. Temperature effects on the strain gages are minimized by water cooling of the hollow interior of the dynamometer shoes. Test frequency was 50 cps for a torsional resonance frequency of the specimen at room temperature of 80 cps. As the temperature is increased beyond 500°C, the applied load frequency must be reduced to maintain a constant difference between it and the resonance frequency of the specimen. The appearance of the fracture and the maximum temperature of the specimen depend on the magnitude of the torque applied. Under small overload a definite fracture angle recurs; at higher loads the character of the failure becomes less predictable, with spalling and - under heavy overloads - local plastic failure in the central part of the specimen, which may become red-hot (at 600°C) and fail in the plane of maximum tangential stresses. The varying character of the fracture depends on the nonuniformity of the plastic deformation and temperature stresses along the length and radius of the specimen (cf. Podstrigach, Ya. S., Chayevskiy, M. I., Akad. n. SSSR, Dokl., v. 121, no. 2, 1958, and Akad. n. SSSR, Izv., Otd. tekhn. nauk, Mekhanika i mashinostroyeniye, no. 1, 1959). To avoid timewise variations of the temperature and, hence, of the mechanical and elastic properties of the specimen, cooling by means of kerosene was employed. Kerosene is neutral (cf. Karpenko, G. V., Vliyaniye aktivnykh zhidkikh sred na vynoslivost' stali - The

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effect of active fluid media on the strength of steel. Moscow. Mashgiz, 1955). Such tests, however, are not representative of specimen behavior in air. The cooled specimens suffer increasing hysteresis losses, and fractures occur at a 65° angle regardless of the magnitude of the cyclic stresses applied. The S-shaped fatigue-strength curve of specimens tested in kerosene confirms the predictions made from dislocation theory (Fujita, F.E., Acta metallurgica, no. 6, 1958, 8) and statistic fatigue theory [Yatskevich, S.N., in Sbornik TsNIITMASH (Central Scientific Research Institute for Technology and Machinery), book 70. Moscow. Afanas'yev, N.N. Statistic theory of the fatigue strength of metals, ZhTF, no. 19, 1940]. There are 3 figures and 6 references (5 Russian-language Soviet, 1 English-language), all cited in the abstract.

ASSOCIATION: None given.

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S/735/61/000/000/007/014

AUTHOR: Chayevskiy, M.I.

TITLE: A machine for fatigue testing with a hermetic chamber.

SOURCE: Akademiya nauk Ukrainskoy SSR. Institut mashinovedeniya i avtomatiki. Mashiny i pribory dlya ispytaniy metallov. Kiyev, 1961, 54-61.

TEXT: The design of a machine for fatigue testing in various liquid media, in an inert gas, or in vacuum is described. The machine is intended for tests of the influence of certain liquid metallic fusions on the fatigue strength of steel. Test data adduced show that a liquid Pb-Sn eutectic bath, at $T=500^{\circ}\text{C}$, will increase the fatigue strength of specimens of 1X18H9T (1Kh18N9T) steel with sharp (45°-apex-angle) stress raisers by 100% in comparison with similar tests in air. The vertically held specimen is rigidly clamped at its lower end. Clamped to the upper end of the specimen is a water-cooled dynamometer extension equipped with wire strain gages which is subjected to cyclic bending by means of an adjustable eccentric wobbler driven by a 1-kw electric motor and axially coupled to the dynamometer extension (DE) by means of a self-centering ball bearing. Tests were made at 40 cps; the resonance frequency of the carbon-steel specimens and their appurtenances was 65-58 cps at temperatures from 20 to 500°C . The stress amplitude was held to within $\pm 25 \text{ kg/cm}^2$ by maintaining the rpm of the electric motor constant by means of a compensation-type automatic electric regulator developed by the author jointly with I.V. Kondratenkov. The electronic regulator is described in detail, and a

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A machine for fatigue testing with a hermetic chamber. S/735/61/000/000/007/014

circuit diagram is provided. Despite the relatively slow action of the regulator, the rpm is maintained to within 0.3-0.4%, since both the load and the input voltage vary but little and slowly. Heating of the specimen is accomplished by means of a NiCr-coil heater. The temperature is calibrated by means of a special control specimen which has a central aperture for a thermocouple. The specimen, the DE, a beaker for liquid-metal fusion, and the electric heater are housed in a hermetically sealed tank. The driveshaft from the (outside) electric motor to the (inside) wobbler passes into the tank through a Van de Graaf (VdG) vacuum seal. A temporary rubber seal is provided for temperature calibration and makeready, when the shaft is not rotating and the VdG seal is inoperative. The above-mentioned improvement in fatigue strength of 1X18H9T (1Kh18N9T) steel with sharp stress raisers, when tested immersed in liquid Pb-Sn eutectic, is attributed to a reactive diffusion of the fused eutectic and the consequent formation of a subsurface intermetallic layer and residual compressive stresses. Fused Pb-Bi does not produce such processes, and the diffusional penetration of the liquid metal into the steel results in a significant loss in fatigue strength. There are 4 figures and 8 references (6 Russian-language Soviet, 1 Russian-language translation of A. Strong's book, "Techniques of the physical experiment," and 1 English-language reference: McKeown, I., Back, Z. H., Metallurgia, the Brit. J. of Metals, v. 38, no. 227, September 1948).

ASSOCIATION: None given.

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S/735/61/000/000/008/014

AUTHOR: Chayevskiy, M. I.

TITLE: On the determination of the residual stresses resulting from the diffusion of low-melting metal fusions in steel.

SOURCE: Akademiya nauk Ukrainskoy SSR. Institut mashinovedeniya i avtomatiki. Mashiny i pribory dlya ispytaniy metallov. Kiyev, 1961, 62-70.

TEXT: Equipment for the determination of residual stresses arising as a result of the diffusion of low-melting metal fusions in the surficial layers of steel specimens exposed to cyclic deformation is described. The interaction between the wetting fusion and the steel involves: (1) dissolution of the steel by the liquid metal; (2) diffusion of the liquid metal into the steel and formation of a solid solution; (3) reactive diffusion between the liquid metal and the steel, with formation of interface compounds; (4) irregular grain-boundary diffusion. The respective compositions of the two metals, their m.p.'s, the length of interaction, the character of the respective phase diagrams of the fusion metals and the steel, and the stress and stress-gradient distribution all affect the kinetics of the process. Prevalence of the adsorptional effect (cf. Rebinder, P. A. In Jubilee Compendium for the 30th Anniversary of the October Revolution, Izd-vo AN SSSR, v. 1, 1947, 123) and of irregular diffusion (o.

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On the determination of the residual stresses...

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Hg, cf. Karpenko, G.V. Prikladnaya mekhanika, v.3, no.1, 1957; of Pb-Bi eutectic, cf. Chayevskiy, M.I., in sbornik "Fizika metallov i metallovedeniye - The physics of metals and metallography," v.10, no.4, 1960) impairs the fatigue strength of steel specimens, but reactive-diffusion processes may enhance it significantly (cf. Chayevskiy, M.I., Akad.n.SSSR, v.124, no.5, 1959, and in sbornik "Metallovedeniye i obrabotka metallov - Metallography and the treatment of metals," no.8, 1959) resulting from residual compressive stresses upon formation of intermetallic compounds in the steel surface layer. These compounds exhibit low-temperature brittleness, higher hardness than that of their components, and conspicuously metallic character. Their high-temperature plasticity permits extrusion, rolling, etc. The process may be of practical importance both for the raising of the heat resistance of a given steel and for the making of curved parts from sheet steel, the latter by one-sided exposure (e.g., at 700°C) to a selected fusion-metal bath; soaking time, thickness of the sheet material, and temperature determine the curvature of the end product. The intermetallic compound of steel and fusion metal has a greater specific volume and creates the compressive stresses that curve the base sheet. Methods for one-sided exposure are explained (tinning and electrolytic surface protection). Determination of the residual stresses is done by two methods: (1) deformation, (2) the force method. The deformation method applied was that of N.N. Davidenko (cf. On residual stresses, in sbornik "Rentgenografiya v primeneni k

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issledovaniyu materialov - X-rays in materials testing, "ONTI, 1936, and ZhTF, v. 1, no. 1, 1931), in which a steel cup is filled with fusion metal, soaked at 400°C for 73 hours, cooled, sliced into rings, the base dimensions of which are measured before and after the rings are slit open. . The variation of the base dimensions of the rings with elevated temperature provides additional information on the residual compressive surface-layer stresses. The force method (cf. Shur, D.M., Zavodskaya laboratoriya, no. 5, 1959, and no. 2, 1960) consists in the removal of the diffusion-affected surface layer and the measurement of the force required to restore the specimen to the curved shape previously engendered by the stresses in the now-removed surface layer. Diffusion processes are accelerated during cyclic deformation of metals (1 German, 2 British references), which may be attributed to processes along the active slip bands or the grain boundaries, and which may lead to the sometimes observed increases in fatigue strength of steel specimens tested in metallic fusion baths. A new testing machine has been constructed comprising a vertical tapered constant-strength cantilever specimen, rigidly clamped at its lower end at the center of a metal beaker, an electrically driven eccentric-weight vibrator clamped to the upper end of the specimen, and a weight-and-pulley arrangement to provide any desired constant transverse pull (via a spring) at the vibrator. One side of the specimen is plated with the test fusion, the other is covered with a protective film. The specimen is mounted in the machine, the beaker is filled

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with the test fusion, and the temperature is raised to and maintained at the desired level. In Al-diffusion tests, the one side may be covered with tin or Pb-Sn eutectic or an electrolytically precipitated Al layer (to accelerate the inception of the diffusion process), and the other side with grease or graphite-grease. For Pb-Bi diffusion tests, the one side may be covered with Pb-Sn eutectic. As the diffusion proceeds, the specimen beam curves away from the side in which the diffusion engenders residual compressive stresses. The transverse (horizontal) force required to straighten the specimen is then a measure of the residual stresses, so long as the diffusion layer is fairly thin. For thick diffusion layers, the specimen is exposed in stages to a wide range of temperatures, and the deflection is measured versus the temperature to obtain a measure of the residual surface stresses, based on consideration of the specimen as a bimetallic body. The specimen is then mounted in a special electrolytic cup, whereupon the diffusion layer is electrically dissolved. The deflection-restoring force method is then used to construct a graph of the distribution of the residual stresses versus the thickness of the layer removed. Summation of the room-temperature stresses and the high-temperature stresses yields the maximal magnitude of the residual stresses. Both the Pb-Sn eutectic and the Pb-Bi eutectic produced compressive surface stresses. Especial attention is directed to the Pb-Bi process. It is known that Fe is neither soluble nor fusible in Pb-Bi and, hence, is incapable of forming a solid solution with Fe. Absence of diffusion of

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Pb-Bi in Fe at 1,000-1,300°C is known (Hansen, Constitution of Binary Alloys. McGraw-Hill Book Co., 1958). According to present-day concepts, the compressive surface-layer stresses observed can be attributed to adsorptional wedging apart of microfissures by the liquid-metals fusion. Rebinder (In Likhtman, V.I., Rebinder, P.A., Karpenko, G.V. Vliyaniye poverkhnostno-aktivnoy sredy na protsessy deformatsii metallov - Effect of surface-active media on metallic deformation processes. Izd-vo AN SSSR, 1954) attributes the arising of a compressive force to the formation of adsorptional layers in microfissures and to the lowering of the free surface energy by the amount $\Delta\sigma_h = \sigma_h(0) - \sigma_h(\Gamma)$. The present paper reports tests which appear to substantiate this "wedging" theory, contrary to the findings of other Soviet authors. There are 4 figures and 22 numbered references (a "ref. 23" is cited in the text but is not listed), of which 14 are Russian-language Soviet, 6 English-language, and 2 German.

ASSOCIATION: None given.

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S/735/61/000/000/010/014

AUTHORS: Chayevskiy, M.I., Popovich, V.V.

TITLE: Multiplex mechanical testing on MII-4Γ (MP-4G) testing machines.

SOURCE: Akademiya nauk Ukrainskoy SSR. Institut mashinovedeniya i avtomatiki. Mashiny i pribory dlya ispytaniy metallov. Kiyev, 1961, 90-94,

TEXT: A modification of the MII-4Γ (MP-4G) machine is described, which affords a significant broadening of the scope of testing on a single machine. Short-term high-temperature tensile tests in air and in liquid-metal fusions are described, and test data, in air and in a Pb-Sn eutectic fusion, of specimens of 2X13 (2Kh13) and 1X18H9T (1 Kh18N9T) are set forth. The modification was inspired by the need for tensile-testing machines for high-temperature operation. A few simple modifications rendered the endurance-testing machine MII-4Γ (MP-4G) usable for for tensile testing with automatic recording of the $P=f(\Delta l)$ curve. The modification comprises the installation of a reduction-gear-equipped electric motor for the displacement of the upper clamp at a prescribed constant rate, a change in the method of holding the specimen, and a change in the design of the clamps. New linear-displacement transducers were made for elongatic measurement. The lower end of the specimen is held by a short tube which is screwed from above into

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the center of an internally water-cooled disk. Two dynamometer rods are screwed into the lower face of the same disk, with their lower ends fixed to the base of the machine. The upper end of the specimen is clamped into the upper traction member of the machine. A disklet is screwed to the upper end of the specimen and a thin feeler rod is screwed through the hollow of the lower holder tube; the lower feeler rod and three feeler rods emanating from the upper disklet provide the two mechanical references for a rheostatic measurement of the elongation of the effective test segment of the specimen. A rack-and-pinion-driven rheochord transducer serves for large plastic deformations ($\Delta l = 50$ mm). For small elastic-plastic deformations of the order of 0.5-1.0 mm the relative longitudinal displacements of the central (lower-end) feeler rod and the three outer (upper-end) feeler rods serve to ovalize an initially circular annular spring equipped with surface wire strain gages. Similarly, annular dynamometer springs with wire strain gages can be used for more sensitive force measurements in lieu of the above-mentioned dynamometer rods. The force and elongation signals are fed to a standard compensation-type potentiometric recorder similar to that used on the micromechanical testing machine of the ИРМ-0,2-ММФМ (IRM-0,2-MIFI) type. A panel-type coordinate recorder is currently being developed (cf. Gur'yakov, I.I. Priborostroyeniye, no. 12, 1959). The Institute of Mechanical Engineering and Automatics, AS UkrSSR, has constructed a compact portable device which draws the $P=f(\Delta l)$ curve on paper sheets 300x280 mm with an error of 0.5% [cf. Chayevskiy, M.I., in zbornik "Temperaturni Card 2/3

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napruzhyennya v tonkostinnykh konstruktsiyakh - Temperature stresses in thin-walled structures, " (in Ukrainian). Vyd-vo AN URSSR, 1959; Chayevskiy, M.I., Kondratenkov, I.V., An Instrument for the recording of $y=f(x,z)$ curves. In the present publication // Test data for hollow specimens of 2X13 (2Kh13) steel, OD 10mm, ID 5mm, l 30mm) in air and in Pb-Sn eutectic. The only appreciable effect of the Pb-Sn eutectic (increased ductility) occurs at temperatures of 600-700°C. Similar tests with solid 1X18H9T (1Kh18N9T) steel specimens (same OD and length) did not reveal any effects on the tensile strength and ductility attributable to the Pb-Sn eutectic. This is in contrast with the improvement in the fatigue strength of notched samples of the same steel observed by M.I.Chayevskiy (see pp. 54-61 of the present publication, Abstract S/735/61/000/000/007/014). The present equipment can be adapted for creep tests with simultaneous imposition of a vibrational load by addition of the device developed by M.I.Chayevskiy and A.N.Tynnyy (see pp. 11-18 of the present publication, Abstract S/735/61/000/000/002/014), with the added installation of a damper required for a smooth transition through any resonance-frequency bands encountered during the acceleration of the vibrator to a desired speed. A universal or multiplex testing machine is thus achieved. There are 3 figures and the 5 Soviet references (4 Russian-language, 1 Ukrainian-language) cited in the abstract.

ASSOCIATION: None given.

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CHAYEVSKIY, B.I.; POPOVICH, V.V.

Remodeling of the MP-4G machine for the tensile test with
automatic recording of the diagram $P=f(\Delta l)$. Zav.lab.27 no.2:218-
219 '61. (MIRA 14:3)

1. Institut mashinovedeniya i avtomatiki AN USSR.
(Testing machines)

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29113
S/020/61/140/005/010/022
B125/B138

AUTHORS: Chayevskiy, M. I., and Likhtman, V. I.
TITLE: Effect of the rate of deformation on strength and ductility
of carbon steel in contact with a fusible metal melt
PERIODICAL: Akademiya nauk SSSR. Doklady, v. 140, no. 5, 1961, 1054-1057

TEXT: For a proper estimate of the effect of temperature and deformation rate on the strength and plasticity of carbon steel, the problem must be related to the critical transition range between brittleness and ductility. If an increase in test temperature can fully eliminate the embrittling effect of the melt on the steel, then it should be possible for the critical temperature of the brittleness-to-plasticity transition to be shifted toward higher or lower values by changing the rate of deformation. This is confirmed by experiment. Fig. 1 shows the curves $\sigma = \sigma(\epsilon)$ for samples of steel 20 at 400°C. At a deformation rate of 10 mm/min, the melts have an embrittling effect on the steel; at 0.055 mm/min, however, the ductility of the steel is restored or even increased. Similar results are obtained in stress-rupture tests at quite low stresses. The

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stress-to-rupture time of samples tested in contact with the molten metal was not longer than those tested in air. The greatly increased ductility of steel due to the action of a melt at a high deformation rate was confirmed by impact toughness tests. With samples of normalized steel 35, the energy of 5.5 kgm of the impact tester was not enough to fracture a steel sample wetted in a Pb-Sn eutectic at 300-400°C, whereas the unwetted samples fractured easily. Tests with steel 45 quenched in oil also showed that increased ductility always occurs when a metal is deformed in any surface-active medium. This effect is due to the fact that these conditions facilitate the withdrawal of dislocations to the surface of the metal undergoing deformation. Although the surface condition of the sample has no particular influence on strength and ductility under ordinary conditions, it nevertheless plays the decisive part if the sample is in contact with a fusible metal melt. In wetted and turned samples of steel 20, the fracture occurs in the plane of the maximum shear stresses, and the sample surface is covered with annular cracks which are the traces of the lathe turning treatment. These facts mean that suitable selection of the heating process will prevent crack formation under the simultaneous action of the melt and temperature stresses. Besides this, the increased

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Effect of the rate of deformation on...

ductility of the steel due to the melt under impact load shows that certain melts can be used to facilitate deformation in the die forging of steel. There are 4 figures and 7 Soviet references.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences USSR)

PRESENTED: April 18, 1961, by P. A. Rebinder, Academician

SUBMITTED: January 24, 1961

Fig. 1. Curves $\sigma = \sigma(\epsilon)$ obtained by testing steel 20 samples in the state described at 400°C. Legend: (1) Testing in air at $V = 10$ mm/min; (2) the same at $V = 0.055$ mm/min. (I) Testing of wetted samples in a melt of Pb-Sn eutectic at $V = 10$ mm/min; (II) the same in a melt of Pb-Bi eutectic at $V = 10$ mm/min; (III) the same in a melt of Pb-Sn eutectic at $V = 0.055$ mm/min; (IV) the same in a melt of Pb-Bi eutectic at $V = 0.055$ mm/min.

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PHASE I BOOK EXPLOITATION

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Soveshchaniye po ustalosti metallov. 2nd., Moscow, 1960.

Tsiklicheskaya prochnost' metallov; materialy vtorogo soveshchaniya po ustalosti metallov, 24 - 27 maya 1960 g. (Cyclic Metal Strength; Materials of the Second Conference on the Fatigue of Metals, held May 24 - 27, 1960) Moscow, Izd-vo AN SSSR, 1962. 338 p. Errata slip inserted. 2800 copies printed.

Resp. Ed.: I. A. Odintsov, Corresponding Member of the Academy of Sciences of the USSR; Ed. of Publishing House: A. N. Chernov; Tech. Ed.: A. P. Guseva.

PURPOSE: This collection of articles is intended for scientific research workers and metallurgists.

COVERAGE: The collection contains papers presented and discussed at the second conference on fatigue of metals, which was held at the Institute of Metallurgy in May 1960. These papers deal with the nature of fatigue fracture, the mechanism of formation

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Cyclic Metal Strength (Cont.):

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and growth of fatigue cracks, the role of plastic deformation in fatigue fracture, an accelerated method of determining fatigue strength, the plotting of fatigue diagrams, and various fatigue test methods. New data are presented on the sensitivity of high-strength steel to stress concentration, the effect of stress concentration on the criterion of fatigue failure, the effect of the size factor on the strength of metal under cyclic loads, and results of endurance tests of various machine parts. Problems connected with cyclic metal toughness, internal friction, and the effect of corrosion media and temperature on the fatigue strength of metals are also discussed. No personalities are mentioned. Each article is accompanied by references, mostly Soviet.

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S/813/62/000/001/006/008
E193/E183

AUTHOR: Chayevskiy, M.I.
TITLE: The mechanism of fracture of metals under the action of molten, low melting point alloys
SOURCE: Akademiya nauk Ukrayins'koyi RSR. Instytut mashynoznavstva i avtomatyky, L'viv. Voprosy mekhaniki real'nogo tverdogo tela. no.1. Kiev, 1962. 80-94
TEXT: A low melting point, liquid, metallic phase in contact with steel may profoundly affect its mechanical properties, reducing its UTS and ductility and, depending on the composition of the liquid phase, either improving or impairing its fatigue strength. The present author critically examines the following four hypotheses put forward to explain the mechanism of this effect: 1) the theory that the effect is similar to stress-corrosive cracking; 2) the hypothesis that the action of the molten metal consists in the formation of brittle alloys; 3) P.A. Rebinder's adsorption theory; 4) the hypothesis according to which the deterioration of the mechanical properties of steel is caused by

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gradual weakening of the atomic bonds, brought about by diffusion of the liquid phase into solid. He rejects the first two of these hypotheses as conflicting with experimental evidence, and concludes in favour of Rebinder's adsorption theory which provides a basis for satisfactory explanation of many phenomena associated with the effect under consideration. The loss of strength of a metal in contact with a liquid phase can be attributed to the fact that an adsorbed film of a surface-active substance lowers the surface tension of the solid, thus facilitating initiation of plastic shear at relatively low stresses. Lower surface energy of a solid metal facilitates also the emergence of dislocations onto its surface which, under certain conditions, may improve the mechanical properties of the metal. This view is supported by the results of time-to-rupture tests conducted at 300 °C on annealed copper in air and in contact with molten Pb-Sn eutectic. The hypothesis according to which a liquid phase brings about a gradual weakening of the atomic bonds in the direction of the applied tensile stress does not contribute anything new to the elucidation of the problem. It merely states in more precise terms that atomic interaction in

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a deformed metal can decrease as a result of interstitial diffusion of foreign atoms which leads ultimately to brittle fracture; in the case of certain solid/liquid phase combinations, however, a certain minimum level of stress has to be attained in the solid phase before this mechanism can operate.

There are 5 figures.

SUBMITTED: June 20, 1961

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CHAYEVSKIY, M.I

36272

S/021/62/000/004/007/012

D299/D302

10.7400

AUTHORS: Chayevs'kyi, M.Y., and Karpenko, H.V., Corresponding
Member of the AS UkrRSR

TITLE: On the mechanism of fatigue failure of steel under the
action of external media

PERIODICAL: Akademiya nauk UkrRSR. Dopovidi, no. 4, 1962, 461-464

TEXT: The mechanism of fatigue failure of steel under the adsorp-
tive effect of the medium, is considered. The external media may
have the effect of either lowering, or increasing the fatigue
strength of steel. Owing to the fact that cracks start developing
at the surface of specimens (in the fatigue process), the lifetime
of metals under cyclic stresses depends considerably on the exter-
nal medium and the surface state of the specimen. A figure shows
the results of investigations (conducted by the authors) on the ef-
fect of Borislav oil on the endurance of steel 20X (20Kh). Thereby,
the lifetime of the specimens increased considerably under overloads
as well as the endurance limit. Other experiments (by various in-
vestigators) have shown that surface-active media which facilitate
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X

On the mechanism of fatigue failure ... S/021/62/000/004/007/012
D299/D302

the formation of slip lines, cause a lowering in endurance. With respect to fatigue failure, due to electrochemical corrosion, it was found that if the cyclic stresses are large, the fatigue failure is related to cathode processes; in case of small stresses, it is related to anode processes. The media which most commonly interact with steel, are fusible-alloy melts which are adsorbed. After adsorption, dissolution and diffusion processes take place. The kinetics of these processes depend on various factors (composition of alloy and of steel, ratio of melting points, etc.). A figure shows the results of experiments on the effect of mercury on the endurance of steel Y8 (U8). Here, too, it was found that large cyclic stresses lead to an increase in lifetime, whereas small stresses, close to the fatigue limit, facilitate the formation of slip lines. The use of melts which form (in the surface states of steel) intermetallic compounds, is very promising. Thus, by using the melt Pb-Sn, it is possible to considerably increase the endurance of steel. Under the adsorptive effect of the medium, a kind of inversion of the endurance curves, takes place; thereby the lifetime increases and the fatigue limit decreases. In the case of melts, interacting with steel, the converse happens: The lifetime decreases and the fatigue

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On the mechanism of fatigue failure ... S/021/62/000/004/007/012
D299/D302

limit increases. In conclusion, a thorough knowledge of the effects of the medium, under cyclic stresses, is needed for design of machine parts in many branches of industry. There are 2 figures and 28 references: 14 Soviet-bloc and 14 non-Soviet-bloc (including 1 translation). The 4 most recent references to the English-language publications read as follows: N.F. Mott, Acta metallurgica, 3, 6, 1958; P.J.E. Forsyth, C.A. Stubbington, J. Inst. Metals, 7, 85, 1957; A.H. Cottrell, D. Hull, Proc. Roy. Soc., A, 2, 1229, 1957; National Bureau of Standards, "Technical News", bulletin, 844, 1960.

ASSOCIATION: Instytut mashynoznavstva i avtomatyky AN URSR (Institute of the Science of Machines and Automation of the AS UkrRSR)

SUBMITTED: October 2, 1961

Card 3/3

X

S/676/62/009/000/002/010
A006/A101

AUTHOR: Chayevskiy, M. I.

TITLE: The use of liquid-metal melts in various industrial fields

SOURCE: Akademiya nauk Ukrayins'koyi RSR. Instytut mashynoznavstva i avtomatyky. L'viv. Nauchnyye zapiski. Seriya mashinovedeniya, v. 9, Voprosy mashinovedeniya i prochnosti v mashinostroyenii. no. 8, 11 - 21

TEXT: The use of low-melting metal melts as operational media is illustrated by a number of examples in the field of thermal power engineering; foundry and heat treatment of metals; machine and instrument building and the glass industry. Except for a heat supply system in a Soviet metallurgical combine, using mercury or a sodium and potassium melt as heat carriers, all the models or systems presented are of American or British origin. They include: heat treatment and bright annealing furnaces; a system for cooling the valve of an internal combustion engine; a high-sensitive mercury bearing; electromagnetic pumps for the transportation of liquid metals, and the production of high-quality

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The use of liquid-metal melts in...

S/676/62/009/000/002/010
A006/A101

plate glass with the use of a molten metal bath. The author concludes that the wide use of liquid-metal melts as heat carriers will be only possible, when the problem concerning the operational capacity of materials being in contact with the melts has been solved. There are 6 figures.

SUBMITTED: June 26, 1961

Card 2/2

11.9600

11.3900

44050

S/676/62/009/000/003/010

A006/A101

AUTHOR: Chayevskiy, M. I.

TITLE: Some generalizing conclusions on the effect of liquid metal melts upon the strength and ductility of metals

PERIODICAL: Akademiya nauk Ukrayins'koyi RSR. Instytut mashynoznavstva i avtomatyky, L'viv. Nauchnyye zapiski. Seriya mashinovedeniya. v. 9, 1962, Voprosy mashinovedeniya i prochnosti v mashinostroyeni, no. 8, 22 - 29

TEXT: The authors carried out an experimental investigation which makes it possible to generalize the effect of temperature, deformation rate and melt type upon the strength and ductility of metals which are in contact with liquid metal melts. The deformation, leading to the breakdown of a steel specimen, which is in contact with a liquid metal melt, can be lesser or greater than the deformation required for the failure of a specimen in air. The former case corresponds to embrittlement, the latter to plasticizing. Brittle failure of steel under the effect of a low-melting metal melt is only observed during the diffusion of the

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S/676/62/009/000/003/010

A006/A101

Some generalizing conclusions on the...

metal melt into the steel volume; it is, as a rule, accompanied by reduced fatigue strength. Embrittlement increases at a longer contact with the melt, higher temperatures and at a reduced deformation rate. In melts which do not diffuse into strained steel specimens, a plasticizing effect may arise at elevated temperatures and reduced deformation rate. The critical transition temperature from brittleness to ductility depends on the type of strained state, deformation rate and the melt type. Therefore, both effects can be observed for various steel grades, depending on the selection of the aforementioned factors. Carbon and low carbon steels 2X13 (2Kh13) and 1X18H9T (1Kh18N9T) can satisfactorily operate in contact with Na, K, Hg, Pb, Sn and Bi type melts and Pb-Sn, Pb-Bi, Na-K eutectics under static load and at definite temperatures; the deformation should not exceed critical values in order to prevent diffusion of the melt into the metal volume. Under cyclic loads, the fatigue strength increases, if melts of Sn and Pb-Sn eutectics are used, in particular, for specimen with a sharp stress concentrator. Carbon steel parts in contact with Pb-Sn eutectics can operate under cyclic loads at up to 400°C, and 1Kh18N9T steel parts at up to 500°C. The effect of low-melting metal melts on cyclic-deformed steel depends mainly on the deformation rate. A sharp decrease of this factor may fully eli-

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Some generalizing conclusions on the...

S/676/62/009/000/003/010
A006/A101

minate the embrittling effect of the Pb-Sn melt even in the case of alternating plastic deformation of the steel. The investigation shows that steel parts can operate without breakdown if the metal melts are properly selected. There are 3 figures.

SUBMITTED: June 20, 1961

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44051

S/676/62/009/000/004/010
A006/A101

11.9600

AUTHOR: Chayevskiy, M. I.

TITLE: The effect of cyclic deformation rate on the fatigue strength of steels affected by low-melting metal melts

SOURCE: Akademiya nauk Ukrayins'koyi RSR. Instytut mashynoznavstva i avtomatyky, L'viv. Nauchnyye zapiski. Seriya mashinovedeniya. v. 9, 1962, Voprosy mashinovedeniya i prochnosti v mashinostroyenii, no. 8, 30 - 33

TEXT: To eliminate embrittlement of steel in contact with low-melting metal melts, the author studied the possibility of preventing the diffusion of the melts into the volume of the steel specimen by reducing the deformation rate in cyclic loading. Steel specimens were subjected to cyclic torsion tests in air and in low-melting metal melts. It was observed that the torsion of normalized 50 grade steel specimen in Pb-Sn eutectic melts at 400°C reduced strongly the cyclic strength as compared to tests performed in air at a loading rate as high as 4.6 radian/min. A sharp decrease of the deformation rate down to 1.7 radian/hour caused the complete insensitivity of the specimens to the effect of

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The effect of cyclic deformation rate on...

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A006/A101

the melt; they withstood the same number of cycles as in air. On the basis of the experiment performed, a method was developed to establish safe conditions of cyclic loading for steel affected by the aforementioned melts. It is concluded that an extended effect of surface-active substances on metals does not always impair but may improve their mechanical properties, in particular, ductility. There are 2 figures.

SUBMITTED: June 23, 1961

Card 2/2

14C52

S/676/62/009/000/005/010
A006/A101

11.9600

AUTHORS: Tynnyy, A. N., Chayevskiy, M. I., Teterskiy, V. A.

TITLE: On the possibility of using liquid metallic melts as lubricants

SOURCE: Akademiya nauk Ukrayins'koyi RSR. Instytut mashynoznavstva i avtomatyky, L'viv. Nauchnyye zapiski. Seriya mashinovedeniya. v. 9, 1962, Voprosy mashinovedeniya i prochnosti v mashinostroyenii, no. 8, 41-46

TEXT: The authors suggest the use of liquid metallic melts as lubricating materials. When salt melts, containing sulfur and chlorine, are used, modified wear-resistant surface layers are formed during the operation of the parts, as a result of friction. This leads to the suggestion that conventional structural and alloyed metals might be used for units operating at high temperatures. Experiments were carried out with a special worm reducer and Wood's alloy (50% Bi, 12.5% Cd, 25.0% Pb, 12.5% Sn) as a lubricant. The bearings in the reducer assemblies were designed in such a manner that the liquid metallic melt greased only the worm thread and the teeth of the worm gear. The bearings were greased

Card 1/2

On the possibility of using...

S/676/62/009/000/005/010.
A006/A101

with mineral oil. The tests show that the use of Wood's alloy as a lubricant prevents galling of the operational surfaces. The new method will eliminate special devices for the cooling of friction parts in units operating at 500 to 1,000°C and will raise the efficiency of friction pairs. There are 2 figures.

SUBMITTED: June 22, 1961

Card 2/2

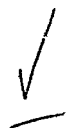
S/659/62/009/000/012/030
1003/1203

AUTHOR: Chayevskiy, M. I.

TITLE: The influence of intermetallic compounds on the surface of steel, on the fatigue resistance during cyclic bending and torsion, under different conditions of stress

SOURCE: Akademiya nauk SSSR. Institut metallurgii. Issledovaniya po zharoprochnym splavam. v. 9. 1962. Materialy Nauchnoy sessii po zharoprochnym splavam (1961 g.), 88-96

TEXT: The results given are of investigations on the fatigue resistance of steel No 50 under various conditions including testing in molten Pb-Bi and Pb-Sn eutectics. The results of other works are also discussed and the conclusion is drawn that the method of increasing the fatigue resistance of steels and other alloys by creating a layer of intermetallic compounds on their surface is very promising. There are 6 figures.



Card 1/1

CHAYEVSKIY, M.I. [Chayevs'kiy, M.I.]

Effect of diffusive penetration of a melt on the ultimate strength of steel. Dop. AN URSSR no.12:1603-1607 '62.

(MIRA 16:2)

1. Institut mashinovedeniya i avtomatiki AN UkrSSR. Predstavleno akademikom AN UkrSSR I.M. Fedorchenko.

(Strength of materials) (Steel—Testing)

CHAYEVSKIY, M.I.

Effect of intermetallic compounds in the surface layer of steel
in various states of stress on its strength under cyclic flexure
and torsion. Issl. po sharopr. splav. 9:88-96 '62. (MIRA 16:6)
(Steel--Testing) (Case hardening)

CHAYEVSKIY, M.I.; TYNNY, A.N.

Machine for testing specimens for cyclic torsion and their
simultaneous axial tension. Zav. lab. 28 no.9:1128-1131 '62.
(MIRA 16:6)

1. Institut mashinovedeniya i avtomatiki AN UkrSSR.
(Testing machines)

355hQ

S/020/62/142/006/013/019
B104/B108

18.8200

AUTHOR: Chayevskiy, M. I.

TITLE: Stress changes in the surface layer of cyclically deformed steel under the action of low-melting metal melts

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 142, no. 6, 1962, 1294-1297

TEXT: The residual stress in the surface layer of steel was determined with the arrangement shown in Fig. 1. The specimens, beams of equal strength, are covered on one side with a eutectic fusion (Pb-Bi, Pb-Sn). Flexural vibrations are set up in the specimens by a vibrator. During deformation the fusion diffuses into the metal, produces a compressive stress and buckles the specimen in the direction of the arrow. The bending attains a definite value Δf_1 at a definite temperature after some time.

On cooling to room temperature the bending is decreased to Δf_2 . On reheating the value Δf_1 is again attained. The stress in the surface layer can be determined by determining the flexural stress that produces the same bending of the specimen. In the annealed state the stress σ_1

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X

Stress changes in the surface layer...

S/020/62/142/006/013/019
B104/B108

in the surface layer of steel 50 is 15-22 kg/mm² when the specimen is cyclically deformed with ± 28 kg/mm². On cooling to room temperature, σ_1 decreases to $\sigma_2 = 2-3$ kg/mm². The compressive stress in the surface layer is caused by the reduction of the work required for the formation of new microsurfaces through adsorption. By the formation of new microsurfaces the volume of the surface layer is increased. There are 3 figures and 15 references: 11 Soviet and 4 non-Soviet. The three references to English-language publications read as follows: J. Holden, N.R.L. Report HT 75/54 (1954); R. F. Hansteck, Proc. Phys. Soc. Lond., 59, 275 (1947); M. Hansen, Constitution of Binary Alloys, N.Y., 1958.

ASSOCIATION: Institut mashinovedeniya i avtomatiki Akademii nauk USSR
(Institute of Science of Machines and Automation of the
Academy of Sciences UkrSSR)

PRESENTED: April 12, 1961, by P. A. Rebinder, Academician

SUBMITTED: April 10, 1961

Card 2/4

35663

S/020/62/143/001/018/030
B104/B108

18.110

AUTHORS: Chayevskiy, M. I., Bryukhanova, L. S., and Likhtman, V. I.

TITLE: Durability of steels in the presence of active metal melts

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 143, no. 1, 1962, 92-94

TEXT: Specimens of steel Cr 50 (St 50) in normal state, with a test length of 30 mm and a diameter of 10 mm were investigated. Part of the specimens were provided with 0.5 mm deep notches (edge angle 45°) as stress concentrator. In the presence of a eutectic Pb-Sn alloy, the logarithm of the time up to rupture of the specimen at a deformation rate of about 10% per minute suddenly drops (Fig. 1). This destruction is not related to thermal activations. Zn-Sn melts with 50% Sn immediately form compounds in the cracks of the steel specimens owing to their high surface activity. Thus, the stress ranges in the specimens are widened very much. The reduction in surface energy owing to adsorption is greater than for Pb-Sn melt. Consequently, the stress at which the logarithm of the time up to destruction suddenly drops, is much smaller for Zn-Sn than for Pb-Sn (Fig. 2). Sn-Cu melts (5% Cu) are even more active. There are 2 figures

Card 1/2

Durability of steels in the ...

S/020/62/143/001/018/030
B104/B108

and 5 references: 4 Soviet and 1 non-Soviet. The reference to the English-language publication reads as follows: G. W. Austin, J. Inst. Met., 58, 1 (1936).

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences USSR)

PRESENTED: May 16, 1961, by P. A. Rebinder, Academician

SUBMITTED: May 3, 1961

Fig. 1. Durability of St 50 as a function of stress at 400°C.

Legend: (1) specimens without notch; (2) specimens with notch; (I) specimens without notch in Pb-Sn melt; (II) specimens with notch in Pb-Sn melt; (τ) time up to rupture; (p) stress.

Fig. 2. Durability of St 50 as a function of stress at 400°C, (specimens without notch).

Legend: (1) specimens in air; (2) specimens in Zn-Sn melt; (τ) and (p) as in Fig. 1.

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ACCESSION NR: AT4023773

8/2723/63/000/002/0007/0023

AUTHOR: Chayevskiy, M. I.

TITLE: Effect of adsorptive plastification and accompanying phenomena in changing the mechanical properties of metals

SOURCE: AN UkrRSR. Instytut masyny*nohnavstva i avtomaty*ky*, L'viv. Vliyanie rabochikh sred na svoystva materialov (Effect of active media on the properties of materials), no. 2, 1963, 7-23

TOPIC TAGS: diffusion, adsorptive plastification, metal plastification, metal adsorption, adsorption

ABSTRACT: The existence of the adsorptive effect caused by plastification, originally discovered by P. A. Rebinder, has been corroborated in many publications. However, the consequences of and phenomena accompanying this effect are still unknown. The author reviews the literature in the field of plastic deformation in crystalline metals, with special attention to the effective strengthening coefficient (which expresses the relationship between shear stress and specific crystallographic displacement) and the true strengthening coefficient (strengthening of the shear plane) which expresses the relationship between shear stress and

Card 1/2

ACCESSION NR: AT4023773

the absolute displacement of parts of the crystal. Various authors have different opinions on the causes of variations in these coefficients. Some say that surface-active substances influence them, while others think they depend on the surface film. The present author feels that both mechanisms must be considered. He also points out that mechanical finishing and heat treatment strengthen the metal surface, but that at higher temperatures the metal loses its stability and diffusion processes may be accelerated. The use of Al-Sn-Pb melts is recommended. Orig. art. has: 4 formulas and 4 figures.

ASSOCIATION: Instytut maszynoznawstwa i automatyki, AN UKR SSR Lvov /
(Institute of Mechanical Technology and Automation, UkrSSR)

SUBMITTED: 00

DATE ACQ: 10Apr64

ENCL: 00

SUB CODE: MM

NO REF SOV: 027

OTHER: 024

Card 2/2

ACCESSION NR: AT4023774

S/2723/63/000/002/0024/0039

AUTHOR: Chayovskiy, M. I.; Shatinskiy, V. F.

TITLE: Fatigue strength of 20Kh steel in a nitrate-nitrite melt

SOURCE: AN UkrRSR. Insty*tut mashy*noznastva i avtomaty*ky*, L'viv. Vlivaniye rabochikh sred na svoystva materialov (Effect of active media on the properties of materials), no. 2, 1963, 24-39

TOPIC TAGS: steel, 20Kh steel, steel physical property, fatigue, steel fatigue strength, nitrate nitrite melt, anode polarization, cathode polarization

ABSTRACT: Using techniques and apparatus described previously (M. I. Chayevskiy, Izd. Instituta tekhniko-ekonomicheskikh informatsiy, Tema 32, No. 11 - 58 -3/2, 1958; Mashiny* i pribory* dlya ispy*taniya metallov, vy*p. 1, Izd-vo AN USSR, 1962), the authors investigated the fatigue strength (cyclic bending) of 20Kh steel in a nitrate-nitrite melt (50% KNO₃, 40% NaNO₃, 7% NaNO₂) at 400-600C, either in the absence of a current or with anode or cathode polarization, in order to determine the interaction between the deformed metal and the melt under varying conditions of stress. Corrosion was also studied under conditions varying from static to stirring of the melt, alone or combined with cyclic bending stress and/or cathode polarization. As shown in Fig. 1 of the Enclosure,

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ACCESSION NR: AT4023774

fatigue strength at 400C was practically the same in the melt as in air and there was no significant corrosion, due to the formation of a protective oxide film. At 500C, the fatigue strength was increased 30% in the melt and there was some corrosion, which was increased by bending stress; this is explained by the formation of microanodes at the Cr components of the steel. At 600C, fatigue strength was higher in the melt only up to 2.6×10^6 cycles, after which rapid failure ensued. As shown in Figure 2 of the Enclosure, the fatigue strength in the nitrate-nitrite melt was considerably reduced by cathode polarization, even at 400C. The interaction between the melt and the deformed metal thus results in processes of adsorption, diffusion, and corrosion which are controlled, to some extent, by the electrical potential. It is concluded that 20Kh steel may be used for machine parts in contact with nitrate-nitrite melts up to 500-550C, after which corrosion becomes too intense. Cathode processes resulting in the deposition of metal salts from the melt which interact with the steel to form an intermetallic protective layer can be recommended as a means of increasing the working capacity of steel parts. Orig. art. has: 6 figures.

ASSOCIATION: Insty*tut mashy*nozhavstva i avtomaty*ly* AN UkrRSR, Lvov
(Institute of Mechanical Technology and Automation, AN UkrRSR)

SUBMITTED: 00

DATE ACQ: 10Apr64

ENCL: 02

SUB CODE: MM

NO REF SOV: 017

OTHER: 004

Card 2/4

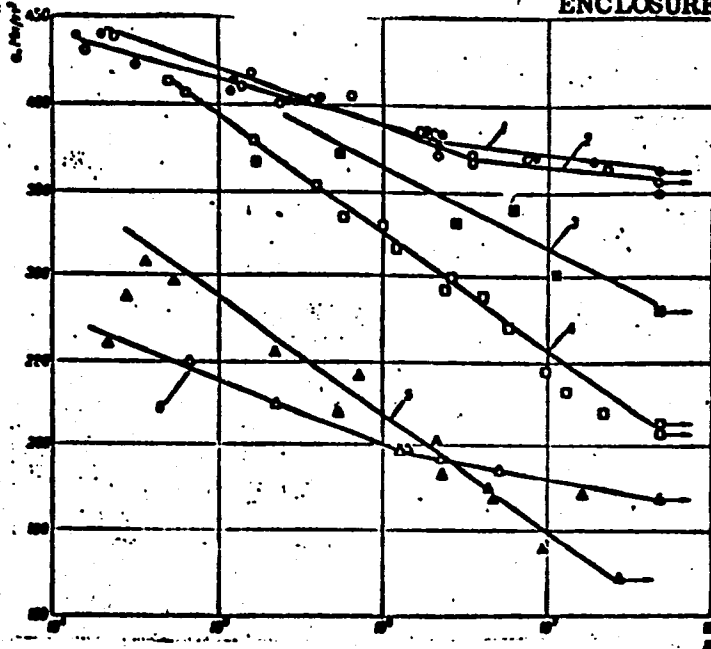
ACCESSION NR: AT4023774

ENCLOSURE:01

Fig. 1 - Fatigue strength of samples of 20Kh steel:

2, 4, 6 - in air at temperatures of 400, 500, 600C, resp.;

1, 3, 5, - in a nitrate-nitrite melt at the same temperatures.



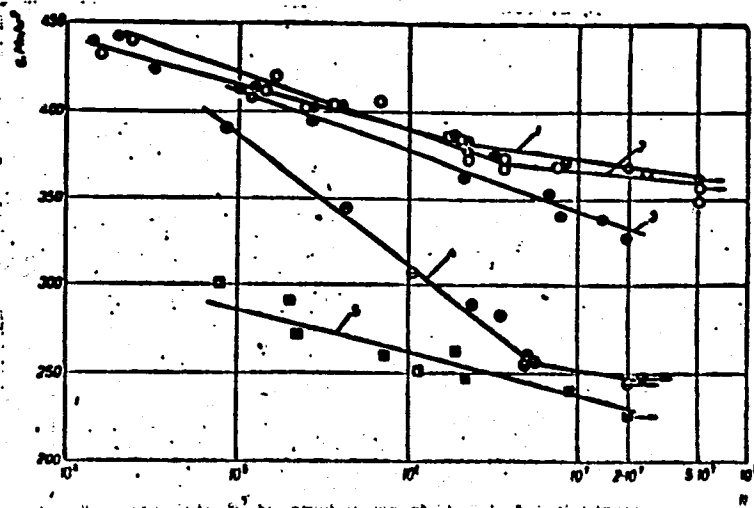
Card 3/4

ACCESSION NR: AT4023774

ENCLOSURE: 02

Fig. 2 - Fatigue strength of samples of 20Kh steel at 400C:

1 - in nitrate-nitrite melt; 2 - in air; 3 - in nitrate-nitrite melt with an anode potential of $D = 0.15 \text{ a/cm}^2$; 4 - in nitrate-nitrite melt with a cathode potential of $D = 0.15 \text{ a/cm}^2$; 5 - in a sodium melt.



Card 4/4

ACCESSION NR: AT4023775

8/2723/63/000/002/0040/0047

AUTHOR: Chayevskiy, M. I.; Shatinskiy, V. F.

TITLE: Variations in strength of 20 Kh steel samples under the influence of Al-Sn-Pb melts

SOURCE: AN UkrRSR. Insty*tut mashy*noznastva i avtomaty*ky*, L'viv. Vliyaniye rabochikh sred na svoystva materialov (Effect of active media on the properties of materials), no. 2, 1963, 40-47

TOPIC TAGS: steel, 20 Kh steel, steel strength, aluminum melt, tin melt, lead melt, metal bath

ABSTRACT: When using melts of low temperature metals as working media it is advisable to employ alloying elements which form heat resistant intermetallic layers on the steel, thus lowering the dissolving rate, strengthening the grain boundaries and increasing the cyclic heat resistance. In the present study, 3.8% Al was added to a eutectic melt of Pb and Sn and samples of 20 Kh steel were tested for rupture strength (deformation rate of 0.9 - 160 μ /sec.) and fatigue resistance (cyclic bending at 40 cps) in either air or the melt at 400-600C.

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ACCESSION NR: AT4023775

These studies confirmed previous findings on the durability of 20 Kh steel in such melts, due to the formation of an intermetallic protective layer. The formation of this layer, which increased the fatigue resistance 28 x at 400C and 9 x at 600C, was confirmed by metallography; the thickness of the layer varied from 0.002-0.05 mm. This layer eliminates surface defects, causes compression at the metal surface, leads to a more uniform distribution of dislocations at the surface, and lowers the solubility of the steel in the melt, increasing the durability of the sample. The authors say that it is still too early to recommend aluminum alloying elements for liquid metal heat carriers. However, the results of these tests show it is possible to increase the durability of steel parts working under such conditions. Orig. art. has: 3 figures.

ASSOCIATION: Insty*tut mashy*noznastva i avtomaty*ky, AN UkrRSR Lvov
(Institute of Mechanical Technology and Automation, AN UkrRSR)

SUBMITTED: 00

DATE ACQ: 10Apr64

ENCL: 00

SUB CODE: MM

NO REF SOV: 012

OTHER: 001

Card 2/2

CHAYEVSKIY, M.I.; SHATINSKIY, V.F.

Effect of polarization on the fatigue strength of steel in a
fused nitrate and nitrite mixture. Fiz. met. i metalloved. 15
no.5:697-702 My '63. (MIRA 16:8)

1. Institut mashinovedeniya i avtomatiki AN UkrSSR, L'vov.
(Steel--Fatigue) (Fused salts)

KARPENKO, G.V.; CHAYEVSKIY, M.I.

Effect of the time factor in mechanical testing in active media.
Zav.lab. 29 no.5:596-597 '63. (MIRA 16:5)

1. Institut mashinovedeniya i avtomatiki AN UkrSSR.
(Metals--Testing)

CHAYEVSKIY, M.I.; SHATINSKIY, V.F.; POPOVICH, V.V.

Thermomechanical treatment of machine parts to protect them from the weakening effects of surface-active media. Dokl. AN SSSR 152 no.5:1096-1099 0 '63. (MIRA 16:12)

1. Institut mashinovedeniya i avtomatiki AN UkrSSR. Predstavleno akademikom P.A.Rebinderom.

L 3205E-65 EWT(m)/EWP(w)/EWA(d)/T/EWP(t)/EWP(k)/EWP(b) Pf-4 MJW/JD/HW

ACCESSION NR: AT4049942

S/2723/64/000/003/0075/0084

AUTHOR: Chaveyskiy, M.I. (Candidate of technical sciences); Shatinskiy, V.F.; Popovich, V.V.

TITLE: Thermomechanical treatment of stress concentrators by rolling with rollers

SOURCE: AN UkrSSR. Fiziko-mekhanicheskiy institut, Vliyaniye rabochikh sred na svoystva materialov, no. 3, 1964, 75-84

TOPIC TAGS: thermomechanical treatment, strain hardening, stress concentrator, rolling, steel strength, steel rolling, torsional deformation, steel 2Kh13, steel 40Kh

ABSTRACT: A method is suggested for strengthening steel at the stress concentrators by thermomechanical treatment consisting of heat treatment, in-rolling of material at the stress concentrators and partial strain hardening of the test piece (e.g. by overall torsional deformation). The main aspect studied in the present paper is the strengthening of steel at the stress concentrators by rolling under optimum conditions. Tests were carried out on cylindrical specimens of steel 2Kh13 and steel 40Kh, in the middle of which there was a stress-concentrating groove with a depth of 1 mm, a bottom radius of 0.2 mm and an angle of 46°. During thermomechanical treatment, the depth of the groove was increased to 1.5 mm by in-rolling with a 20 mm diameter roller that left

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ACCESSION NR: AT4049942

the bottom radius and groove angle unchanged. The rolling temperature was 500-600C, depending on the type of steel, and some samples were also subjected to torsional deformation. Samples were tested in air and also after coating by immersion into a molten eutectic alloy of lead and tin. Optimum thermomechanical treatment resulted in marked increases in strength at the stress concentrators, as evidenced by failures of the samples through the unnotched diameters. Rolling-in at room temperature, however, had no significant effect. The authors conclude that optimum thermomechanical treatment of parts with stress concentrators, which may be semi-finished products, yields parts with increased uniform strength without excessive deformation. For some steels, corrosion resistance is also improved, but if the plasticity of the steel is too low, there may be no beneficial effect. As shown by the results with steel 2Kh13, not all steels can be strengthened by thermomechanical treatment, even if the deformation is carried out in the high stability region of the austenite.

18

ASSOCIATION: none

SUBMITTED: 06Jun63

ENCL: 00

SUB CODE: MM

NO REF SOV: 015

OTHER: 001

Card 2/2

L 23445-65 EPA(s)-2/EWT(m)/EWP(w)/EPF(n)-2/EWA(d)/T/EWP(t)/EPA(bb)-2/EWP(b)
Pt-10/Pt-4 JD/JW/JW/JG

ACCESSION NR: AT4049944

S/2723/64/000/003/0092/0099

AUTHOR: Chayevskiy, M.I. (Candidate of technical sciences); Shatinskiy, V.F.

TITLE: Cyclic twisting of steel in low-melting metallic smelts

SOURCE: AN UkrSSR. Fiziko-mekhanicheskiy institut. Vliyaniye rabochikh sred na svoystva materialov, no. 3, 1964, 92-99

TOPIC TAGS: steel fatigue, steel strength, cyclic twisting, torsion stress, low melting alloy, aluminum alloy, tin alloy, lead alloy, intermetallic compound/steel 50

ABSTRACT: The appearance of large local stresses during cyclic twisting could be the reason for the difficulties encountered during attempts to strengthen steel parts operating under the mentioned conditions. Consequently, it seemed advisable to improve the structure of the surface layer by continuously repairing the defects generated during the cyclic twisting deformations. Since the resistance to fatigue seemed to improve only insignificantly during the cyclic twisting of samples in a Pb-Sn smelt at 400C, the authors proposed (DAN URSR, no. 11, 1962) to stabilize the Pb-Sn action (creating intermetallides) by adding Al to the alloy (Al = 3.8%, Sn = 59.5%, Pb = 36.7%). Tests using normalized steel 50 showed that in the 400-600C interval the alloy improved the durability of the samples, as can be seen on Fig. 1 of the Enclosure. Some authors had established

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earlier (see, e.g., S.N. Zhurkov, FTT, vol. 4, no. 11, 1962) that the lifetime of metals during dilation may be described by

$$\tau = \tau_0 \cdot e^{\frac{U}{kT}}, \quad (1)$$

where τ_0 = a constant independent of the experimental conditions, and the activation energy of disruption U is given by

$$U = U_0 \cdot \gamma \cdot \sigma, \quad (2)$$

(γ characterizes the composition of the material, σ = stress). The torsion tests under discussion showed that here 1. the coefficient τ_0 is not a constant and 2. the activation energy does not depend on stresses (this last result may be due to the smallness of the stresses involved). Orig. art. has: 6 formulas and 7 figures.

ASSOCIATION: none

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NO REF SOV: 010

OTHER: 002

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L 01122-66 EWG(j)/EWT(m)/EWP(w)/EPF(c)/EPF(n)-2/EWA(d)/T/EWP(t)/EWP(z)/EWP(b)/
EWA(c) IJP(c) JD/JW/JG/WB

ACCESSION NR: AP5019660

UR/0369/65/001/003/0343/0349

AUTHOR: Chayevskiy, M. I.

TITLE: Role of impurities in the process of interaction between deformable metal and metallic melt

SOURCE: Fiziko-khimicheskaya mekhanika materialov, v. 1, no. 3, 1965, 343-349

TOPIC TAGS: impurity, metallic melt, deformable metal, aggressive medium, thermodynamic parameter, easily fusible metal, machine metal, high sulfur steel, eutectic reaction, peritectic reaction, deformation kinetics, surface active medium, hard metal

ABSTRACT: The proper approach to calculating the strength of steel work parts in contact with an aggressive medium requires knowledge of determining a large number of thermodynamic parameters of the activity of specific impurities. At present this can be done only in an approximate manner, owing to the lack of a sufficiently reliable standard of comparison. An overwhelming majority of investigations of the mechanical properties of metals has been performed in air atmosphere. But even at room temperature air is not a neutral medium, and the aggressiveness of

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air increases with temperature. Therefore, the results of tests in air cannot be accepted as the standard of comparison and are used only for a relative estimate of the aggressiveness of specific media. Any "absolute" estimate of the aggressiveness of a medium requires performing the tests in a sufficiently high vacuum or in the atmosphere of a spectrally pure inert gas. Thus, knowledge of the strength characteristics of a metal in a vacuum is required to estimate the aggressiveness of air and individual gases. Oxygen, nitrogen, hydrogen, and carbon usually exist in dissolved state in the melts of easily fusible metals interacting with machine metal. Depending on the variation in the free energies of the interacting components, these impurities may either enter the metal from the melt or, conversely, enter the melt from the metal. Obviously such a saturation or depletion of the metal's content of impurities will affect its strength properties and corrosion resistance. The authors illustrate these arguments by describing the effect of air on deformable iron and steel, and particularly the effect of oxygen on the high-sulfur steel and iron containers for sodium and lead-tin melts. Further the role of other impurities in increasing the likelihood of brittle fracture is discussed. An explanation is provided for the mechanism of the decrease in strength under the action of surface-active media: it is based on irregular

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diffusion (migration) over the defects, which leads to a decrease in the interphase surface energy and facilitates the development of cracks. It is shown that the likelihood of eutectic and peritectic reactions is chiefly determined by the degree of distortion and defectiveness ("dispersity") of the hard-metal lattice, this degree being a function of the kinetics of deformation. Therefore, varying the strain rate and temperature is a means of controlling the development of dispersity and obtaining such states of hard metal at which the occurrence of eutectic and peritectic reactions is either precluded or strongly impeded and thus the embrittling effect of the melt is prevented from manifesting itself. Experiments show that the fracture of steel under the action of a melt occurs along the grain boundaries. This is because, in addition to the presence of considerable distortions, the grain boundary is a region where local stresses and vacancies arise most readily. Particularly unfavorable consequences may be caused by the presence of such impurities as Sn, Bi, Pb, and Sb penetrating from melts into the steel. If a melt penetrates through the newly forming defects into a deformable steel, this may lead to the formation of even more readily fusible multi-component compositions and thus, ultimately, to a still greater decrease in strength. Original art. has: 4 figures.

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ACCESSION NR: AP5019660

ASSOCIATION: Fiziko-mekhanicheskii institut AN UkrSSR, L'vov (Physico-Mechanical
Institute, AN UkrSSR)

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L 14430-66 EWT(m)/ETC/F/EPF(n)-2/EWG(m)/EWP(t)/EWP(b) IJP(c) JD/WN/JG/WB 74
71
B

ACC NR: AP6002108

SOURCE CODE: UR/0369/65/001/006/0637/0642

AUTHOR: Chayevskiy, M.I.

ORG: Physicomechanical Institute, AN UkrSSR, L'vov (Fiziko-mekhanicheskiy institut AN Ukr SSR)

TITLE: Thermodynamic activity as a criterion of the disordering effect of corrosive melts 44.55

SOURCE: Fiziko-khimicheskaya mekhanika materialov, v. 1, no. 6, 1965, 637-642

TOPIC TAGS: metal softening, refractory metal, corrosion protection, nonferrous liquid metal

ABSTRACT: Based on an analysis of the effect of a surface-active metallic medium on a refractory metal and experimental data, a rule is proposed for evaluating the disordering effect of a melt on a deformed metal: if a total solution consisting of a more refractory metal and a low-melting melt acting upon it has a negative deviation from the ideal (i. e., from Raoult's law), the low-melting melt will not soften the deformed refractory metal; if the total solution has positive deviations from the ideal, the low-melting melt will soften the deformed refractory metal. For example Ni-Mg, Cu-Mg, and Zr-Sn melts have

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negative deviations from ideality, and therefore it is expected that magnesium melts will not soften deformed copper and nickel, and that the tin melt will not soften deformed zirconium. The formulated rule is also applicable to multicomponent solutions, so that alloys can be developed which will not soften during deformation while in contact with single- or multicomponent melts of low-melting metals. In addition, it is assumed that the rule will permit the prediction of the embrittling effect of gases and salt melts, and will provide a correct approach to the selection of protective coatings for steels operating in corrosive media. Orig. art has: 3 figures and 1 table. 44,55,16

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Card 2/2

E 14427-66 EWT(m)/EWP(w)/EPP(n)-2/EWA(d)/T/EWP(t)/EWP(z)/EWP(b) IJP(c)
ACC NR: AP6002111 MJW/JD/WW/SOURCE CODE: UR/0369/65/001/006/0654/0658

JG
AUTHOR: Chayevskiy, M.I.; Shatinakiy, V.F.; Popovich, V.V.

ORG: Physicomechanical Institute, AN Ukr SSR, L'vov (Fiziko-mekhanicheskiy institut AN Ukr SSR)

TITLE: Role of oxygen in the adsorptive decrease of the strength of steel samples in contact with melts 21

SOURCE: Fiziko-khimicheskaya mekhanika materialov, v. 1, no. 6, 1965, 654-658

TOPIC TAGS: oxygen, steel, adsorption, fatigue strength, lead, bismuth, tin, nonferrous liquid metal

ABSTRACT: Cyclic deformation of steels in melts considerably intensifies the diffusion processes involved in the penetration of the melt or impurities into the steel. The role of oxygen in these processes was studied on 40Kh and 1Kh18N9T steels. The fatigue strength of temper-hardened 40Kh steel in the melt of the lead-bismuth eutectic in contact with air exhibited a substantial drop, whereas in the presence of argon and absence of air this drop did not occur. In melts of the Pb-Sn and Pb-Bi eutectics, the dissolved

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oxygen had no effect on the fatigue strength of this steel. In the Pb-Bi melt, steel 1Kh18N9T, which has a greater affinity for oxygen than this melt, becomes saturated with oxygen coming from the melt, which in turn absorbs oxygen from the air. In the presence of a purified argon atmosphere, the oxygenation ceases, and the fatigue strength of the samples increases. Hence, both the melt and the oxygen dissolved in it participate in the adsorptive decrease of the strength of 1Kh18N9T steel in the Pb-Bi melt, which is in contact with air. In the Pb-Sn eutectic melt, intermetallic films formed on the surface of the steel act as a barrier protecting the steel from oxygen. It is concluded that in order to prevent the negative role of oxygen in reducing the strength of steels by adsorption, it is necessary either to use melts which form surface intermetallic films with the steel, or to alloy the melt with additional components which increase the affinity of the melt for oxygen, or to protect the melt from the action of oxygen. Orig. art. has: 5 figures.

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